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(54) SUBSURFACE SIGNAL TRANSMITTING APPARATUS

UNTERTRÄGIGE SIGNALÜBERTRAGUNGSVORRICHTUNG

EMETTEUR SOUTERRAIN DE SIGNAUX

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Description

Technical Field

[0001] This invention relates to a subsurface signal transmitting apparatus of the type for sensing certain conditions in a bore hole and then transferring them to a surface located receiver.

Background Art

[0002] In the oil industry, it is necessary to obtain and analyze down-hole conditions, such as pressures and temperatures at various elevations. This has been done most commonly in the past by lowering electrically or mechanically operated gauge devices into the well, these gauges being either suspended on a wire line or fastened to available oil well tubular sections. By utilizing conductor wire lines, the information can be transmitted to the surface on a "real-time" bases. When non-conductor lines are employed, the gauge must be withdrawn to the surface so that the data can be either downloaded to a plotter or read directly from an internally scribed chart, thus providing the operator with the desired information. In this process, whether the wire line is used as a suspension member or is strapped to the outside of tubular sections forming a string in the bore hole, damaging of the wire line is not uncommon. The damage or destruction of the wire line can occur when the string of tubular sections sticks within the bore hole, or when the wire line and/or tubing string is being run in or out of the hole. Not only is there the cost of the lost equipment, but such damage adds significantly to the cost of the operation because of the time involved in repairing the equipment and in fishing the equipment from the hole. The process of having to fish also includes the risk of endangering the well itself.

[0003] Other techniques have been developed for transmitting signals which are produced by apparatus located down-hole to the surface, including devices which develop and transmit signals electromagnetically to the surface. Such signals having been received by a receiving apparatus provide instantaneously information on the conditions sensed down-hole. This telemetry technique involves locating down-hole relatively complex equipment and providing a source of power. Structures have been developed for containing such equipment and power source. These structures enable the use of a portion of the tubing string to function as an antenna in the transmission of the signals to the surface. The process of using the tubing string, such as the upper portion of the string, as the antenna involves the provision of a connection which electrically isolates the upper portion from a lower portion of the tubing string so that the output voltage of the down-hole electromagnetic transmitters can be connected across terminals which are electrically isolated from each other.

[0004] The approach of using a telemetry technique for transmitting the information to the surface provides instantaneous readings at a set location of the down-hole sensing equipment and also avoids the use of a wire line. While having significant advantages over other techniques, problems due to the conditions which exist in the bore hole have in many respects hindered successful development in this process. For example, although there exists insulation couplers for use in an arrangement where the upper portion of the tubing is used as an antenna, such couplers have not always functioned satisfactory when the lower portion of the tubular string becomes jammed in the bore hole. This is not uncommon particularly where the lower part of the bore hole deviates from the vertical. Present insulation couplers have not been known to withstand the application of a high torque used in attempting to force the string when jammed, and a severing of the tubing string at the insulation connector results in the lower portion of the tubular string, which houses the expensive telemetry sensing and telemetry equipment, becoming completely disconnected at its down-hole position. Not only is the cost of the equipment involved, but there is the expense involved in reopening the hole and potential damage to the well.

[0005] Moreover, due to the nature of the sensing, power source and transmitting equipment utilized in the telemetry process and the extreme conditions to which the down-hole end of the tubing string is subjected, known methods of mounting such equipment has not always proved satisfactory. While the equipment must be protected, the manner in which it is carried and its connection to the insulation connector must be such that it is readily available for exchanging and servicing.

[0006] Yet another characteristic of some known structures incorporating an insulation coupler is that they are not capable of coping with particular conditions which can develope either above or below the test equipment when located down-hole. The down-hole test equipment is frequently used in conjunction with annular sealing packers, and in the known structures the insulation connector and/or the test equipment and mounting elements, together with the sealing packers, in effect from a complete seal or blockage in the borehole. Accordingly, in the event a pressure build-up develops either above or below the sealing packers, the tubing string can be sucked into or blown out of the bore hole. This can happen with sufficient force to cause severe injury to personnel and damage to equipment.

[0007] US 5138313, which shows the features of the preamble of claim 1, discloses a known electrically insulating subassembly for electrically insulating an upper section of a drill string from a lower section of a drill string to enable a telemetry technique to be used for signalling information to the surface. In this known subassembly an upper box end joint member and a lower pin end joint member are interconnected by way of an electrically insulating gap material retained between an inner sleeve and an outer sleeve and formed in four pieces, namely

an upper end gap block, a mid-gap block functioning primarily to resist tensile and compressive forces, a hexagonal gap block functioning to resist torque forces, and a lower end gap block. However such an assembly is both complex in construction and prone to failure under extreme conditions. CA 676449 discloses an insulated pipe connector for connecting together two pipe sections in an electrically insulating manner. However such an assembly would not be capable of being used to connect together upper and lower parts of a drill string to permit borehole telemetry.

[0008] It is an object of the present invention to provide a connector assembly which may be used in an apparatus for subsurface telemetry signal transmission in order to overcome the above described disadvantage of known devices presently available in this technology.

[0009] According to the present invention, there is provided a connector assembly for connection in a tubing string in a borehole, said connector assembly electrically insulating an upper section of said string above said connector assembly from a lower section below said connector assembly and comprising

an outer housing member,
an inner mandrel member,
said housing member having connection means adjacent one end of said connector assembly for end-to-end attachment of said one end to one of said upper and lower sections of said string, and
said mandrel member having second connection means adjacent the other end of said connector assembly for attachment of said other end of the other of said upper and lower sections,
and an electrical insulator disposed between the housing member and the mandrel member,

characterised in that

said housing member has an internal surface defining a tapered opening through said connection means said internal surface including an internal bore of a large diameter toward one end of said housing member and an internal bore of a smaller diameter toward the opposite end of said housing member, the tapered opening extending longitudinally from said bore of larger diameter to said bore of smaller diameter,
said mandrel member has an exterior surface tapering from a large diameter end portion toward said other end and terminating at a cylindrical end portion defining an exterior surface of smaller diameter, said larger diameter of said exterior surface of said mandrel member being of greater diameter than said bore of smaller diameter in said housing member, and said exterior surface of said mandrel member being disposed within said internal surface of said housing member and providing a clearance between said surfaces, and
said electrical insulator comprises an electrically non-conducting bond material disposed within said clearance between said surfaces.

[0010] It is apparent that, in the use of the insulating connector assembly of the present invention, the outer housing member, which may be connected to the upper section of the tubular string, can function as an antenna for transmitting signals received from equipment mounted in a carrier device connected to the mandrel member. In the case of a tension force being applied to the connector assembly, shear forces are developed in the bond material located in the clearance, but the bond material is also in compression between the two tapered surface portions of the housing and mandrel members. Moreover, because of the direction of taper relative to the connection means at the opposite ends of the connector assembly, the mandrel member cannot be pulled through the housing member by an excessive tensional pull on the tubular string. Even in the event of failure of the bond material in the clearance, the tensional pull results only in the surface portions moving towards an engaging position.

[0011] In a preferred form of the present invention, the housing member has a first connector means adjacent one end of the connector assembly for attachment to an adjacent tubular section of the string above the connector assembly, and the inner mandrel member has a second connection means for attachment to an upper end of an instrument carrier device, the mandrel member being of tubular form defining a central passageway extending from said one end to said other end of said connector assembly. Means is provided for electrically insulating the housing member from the mandrel member. The carrier device includes an elongated tubular member having channels in the exterior surface thereof for accommodating instrument sensing units. The tubular member also has an internal passageway disposed therein and placing a lower end thereof in communication with said passageway in said mandrel member at the upper end thereof. The tubular member has a third connection means at a lower end thereof for attachment of the carrier device to an adjacent section of the tubing string below said carrier device. An electrically insulating by-pass tube extends through the passageways of said mandrel and said carrier device and has fourth and fifth connector means at upper and lower ends thereof, respectively, for connection of the by-pass tube to the upper and lower sections, thus permitting fluid passage through said apparatus.

[0012] In this structure, the by-pass tube extending through the passageways in both the connector assembly and the carrier device provides for fluid communication past the subsurface transmitting apparatus so that pressure build-up either above or below the apparatus is prevented, and accordingly the destructive results which can result from such build-up are avoided.

[0013] The carrier device is adapted to be attached to

the connection means provided by the mandrel member, so that sensing units, which include a transmitting component, can be readily inserted and retrieved from the channels in which they are protected from damage by engagement of the carrier device with the sides of the borehole. The cable which carries the signals to be transmitted can then be located in the provided passage and connected to the antenna providing member of the connection assembly.

Brief Description of The Drawings

[0014] In the accompanying drawings which show an embodiment of the invention, as example,

[0015] Figures 1A, 1B, 1C, 1D, 1E and 1F, when viewed in end-to-end combination as indicated, show a side cross-section view of the subsurface transmitting apparatus of the present invention, and

[0016] Figure 2 is a perspective, exploded view of the carrier device forming part of the apparatus of Figure 1.

Best Mode for Carrying Out the Invention

[0017] Referring now to Figure 1, wherein like reference numbers denote like elements descried herein, the reference number 10 denotes the overall subsurface transmitting apparatus in which the present invention is incorporated. In Figure 1B and 1C, there is shown an insulation coupler 11 and in Figures 1C to IF, as well as Figure 2, there is shown a carrier device 12 of a preferred embodiment of invention. In use, the apparatus 10 is connected at its upper end to a lower end of tubing string (not shown) which is lowered into the bore hole for taking readings of conditions in the bore hole, such as pressure, temperature, relative angle, etc. The readings are transmitted to a receiver at the surface near the top of the bore for recording and analysis by the operator. The apparatus may also be used to compute other information in relation to the equipment status, i.e. the status of various down-hole components, such as valves, safety joints, etc. The tubular string includes other sections which are connected to the lower end of the apparatus 10, and these may include, for example, sealing packers (not shown).

[0018] The insulation coupler 11 is in the form of a connector assembly having an outer housing member 13 and inner mandrel member 14, both of which are formed of metal (Figure 1B). The outer housing member 13 has an outer cylindrical surface 15 which is preferably of the same diameter of the other sections in the tubular string, and it is hollow so as to provide a bore or opening 16 extending therethrough. The opening 16 is of maximum cross-section at its upper end where there is provided a connection means in the form of internal threads 17 for attachment of the outer housing member 13 to a tubular section 20, which has an externally threaded lower end portion 21 of reduced diameter.

[0019] Below the internally threaded upper end of the outer housing member 14, the bore or opening 16 is defined by internal surface 22 which tapers outwardly from the lower end towards the connection means provided by the internal threads 17. The surface 22 is preferably in the form of a conic frustum and wherein the gradient or degree of taper is slight so that the outward taper in cross-section of this portion of the opening 16 is relatively gradual. Below the tapered portion of the opening 16 is a lower portion 23 of the opening 16 which is of less diameter, of course, than the cross-section of the internal threaded portion at the upper end. Substantially along the length of the surface defining the lower portion 23 are a plurality of circumferentially spaced, longitudinally extending grooves 24 which are substantially semi-circular in cross-section. At the very lowermost end of the outer housing section 13, the internal bore or opening 16 is enlarged to provide annular enlarged bore defining a seat 25 for a sleeve 65.

[0020] The inner mandrel member 14 is mainly received within the opening 16 of the outer housing member 13. It has a lower or tail portion 26 (Figure 1C), which is of smaller diameter than its upper end, and the lower portion 26 has external threads 27 which provide connection means for attachment to the upper end of the carrier device 12. The mandrel ends in an end surface 28. The mandrel member 14 is of tubular form and has an opening or bore 30 extending longitudinally therethrough. The bore 30 is of uniform diameter except for a seal receiving enlargement 31 at its upper end. The upper end portion of the mandrel member 14 has an outer surface 32 which tapers outwardly in a direction away from the connector means provided by the threaded lower portion 26. The size of the tapered portion of the mandrel is selected to substantially fill the tapered portion of the opening 16, and the taper is such to match that of the tapered openings, i.e. the gradient or degree of the outer surface 32 which is also a conic frustum is substantially the same as that of the surface 22. When mounted in an assembled condition within the outer housing member a slight gap or clearance 33 remains between surfaces 22 and 32. The thickness of the clearance 33 is substantially constant and is in the order of . 040 inch. Although the degree of taper of the surfaces 22 and 32 is not great, the cross-section area of the mandrel adjacent the upper end of the taper is significantly greater than the cross-sectional area of the opening 16 in the outer housing member 13 adjacent the lower end of the taper of the opening 16.

[0021] Below the tapered surface 32, the mandrel member 14 has a cylindrical portion 34 which has circumferentially spaced, longitudinally extending grooves 35, which are also of substantially semi-circular shape in cross-section. The grooves 24 of the housing member 13 and grooves 32 of the mandrel member 14 align to form a plurality of longitudinal channels or openings, which are substantially circular in cross-section. Each longitudinal opening thus formed has located therein a pin or rod 36 which is also of circular cross-section and

of a diameter to fill the longitudinal opening provided by grooves 24 and 35. The rods are formed of an electrically insulating material, such as a tough plastic material which has a significant shear strength.

[0022] The tubular section 20 which is connected to the upper end of the outer housing member 12 is a substitute connector in that its upper end has an internally threaded tapered bore 37 (Figures 1A and 1B) for receiving an externally threaded lower end portion 40 of a tubular section 41. An internal central bore 42 extends through the tubular section 20, the lower portion of the bore 42 being enlarged at 43 to the same dimension as the enlarged bore 31 in the mandrel member 14 (Figure 1B). The upper end of the enlarged bore in tubular section 20 terminates at a radial shoulder 44, and the lower end of enlarged bore 31 in the mandrel member 14 terminates in a radial shoulder 45. A sleeve 46 of a rigid durable material, which is of a electrically insulating material, is disposed with its opposite ends engaged by the opposed radial shoulders 44 and 45. The diameter of an internal passage 47 in the sleeve 46 is of substantially the same dimension as the bore 30 on the mandrel member 14. O-ring type seals 50 and 51 are disposed in annular grooves formed in the interior surfaces of the enlarged bores 31 and 43 of mandrel member and tubular member 20 to ensure a seal between the sleeve and these members. The upper end of the mandrel member 14 and the lower end of the tubular member 20 are each provided with recessed areas which receive a pair of annular seals 52 and 53, which are, of course, of an electrical insulating nature and provide a seal at the upper end of the mandrel member.

[0023] Accordingly, the outer housing 13 and the mandrel member are not in direct contact with each other, and the mandrel member 14 is not in direct contact with the tubular member 20 which is made of metal and is in direct contact with the outer housing 13. Any member which is in contact with both the outer housing member 13 and the mandrel member 14 or in contact with both the mandrel member 14 and the tubular member 20 are formed of electrically insulating material.

[0024] The inner tapered surface 22 of the outer housing member 13 and outer tapered surface 32 of the mandrel member 14 are separated a distance equal to the thickness of the clearance 33. This clearance, is filled with a bond material 29 which is of an insulating nature and has considerable strength, such as an epoxy. When the shoulder 45 mandrel is held in abutment with the lower end of the sleeve 46, the mandrel member and the outer housing are positioned correctly relative to each other to provide a controlled clearance 33. The bond material 29, then in a liquid form is injected through an opening 54 in the housing member 13, and the material completely fills the clearance and passes down into the spaces adjacent the rods 36. At the upper end, the liquid epoxy is retained by seals 50 and 51. The material 29 then sets to provide a rigid bond connection between the tapered surfaces 22 and 32 capable of transferring normally experienced torque forces between the outer housing member 13 and the mandrel member 14. The bond connection between the tapered surfaces 22 and 33 is also capable of transferring forces through the insulation coupler in the longitudinal direction, such as the weight of the portion of the tubular string below the apparatus which places the bonding material in shear and also in compression as the mandrel member 14 is pulled down relative to the housing member 13.

[0025] In the event of extremely high torsional forces such as in the event of the lower part of the tubular rod becoming jammed, or should the bond material 29 start to fail, torsional forces are transferable from the outer housing member 13 to the mandrel member 14 by way of the rods 36 contained in the groove 24 of the housing member and the grooves 35 of the mandrel member. Of importance in the insulation connection is the direction of the slopes of the surfaces 22 and 32 in relation to the connection means provided by the threaded ends of the housing member 13 and the mandrel member 14. In an upward pull of the tubular string from the bore, such as when a lower portion of the string below the insulation coupler 11 becomes jammed, and this pulling force may occur in combination with a torsional exertion, the bonding material in the clearance, while experiencing shear forces is also in a state of compression between the surfaces 22 and 32. Furthermore, in event of failure of the bonding material, the mandrel member cannot disconnect from the housing member as in the longitudinal directions, the surfaces can simply move toward an engaging position. Accordingly, the costly situation which occurs when the lower portion of the tubular string becomes separated and lodged in a down-hole location is avoided.

[0026] It is apparent that the insulation coupler 11 could be constructed in a manner to be inserted in a tubular string in an inverted orientation and still utilize the basic principle shown in the illustrated embodiment. With obvious modifications, the housing member could be adapted to be connected to the carrier device with the mandrel member, which is electrically isolated from the housing member, being connected to the tubular member above the coupler. The relationship between the tapered surfaces of the two members would still be such that the members could not be separated by an extreme longitudinal pull on the coupler.

[0027] At the lower end of the outer housing member 13, there is provided a plurality of screws one of which is shown at 55 threaded into a hole in the outer surface of the housing member (Figure 1B). A short groove 56 extends from each screw to the lower end of the housing member 13. This provides a terminal connection for an output cable 57 (Fig. 2) extending from the signal transmitter equipment carried by the carrier device 12. Because the outer housing member 13 is insulated from the carrier device and the tubular members carried therebelow, the outer housing and the sections in the tubular

string thereabove function as an antenna for the transmitted signals.

[0028] As previously described, the lower portion 26 of the mandrel member 14 is attached to an upper end of the carrier device 12 which includes an elongated, generally cylindrical body 57 (Figure 1C). The body 57 has an outer surface 60 which is preferably of the same outer diameter as the other tubular members of the string, and it is of tubular form having a longitudinal bore 61 is generally of the same diameter as the bore 30 of the mandrel member 14. The upper end of the bore is enlarged and is provided with internal threads 62 for threaded reception of externally threaded lower portion 26 of the mandrel member 14. The lower end of the enlarged portion of the bore at the upper end of the body 57 provides a shoulder 63 against which the end surface 28 of the mandrel member 13 engages so as to provide a sealed joint. There is further provided an annular groove 58 in the enlarged bore between the threads 62 and the shoulder 63, which groove receives a seal 59.

[0029] At the very upper end of the body member 57 there is an enlarged bore 64 which is of the same diameter as bore 25 in the lower end of the housing member 13. While the lowermost end surface of the housing member 13 and the uppermost end surface of the carrier device 12 are spaced, a sleeve 65, which is formed of an electrically insulating material, spans the space and has opposite ends thereof received in the enlarged bores 25 and 64. Within the seat 25 of the housing member 13, there is an annular groove 66 (Figure 1B). Opposite the groove 66, there is provided an annular groove 67 on the exterior surface of the mandrel member 14. The grooves 66 and 67 contain seals 70 and 71 which engage the exterior and interior surfaces, respectively, of the end of the sleeve 65 extending into the seat 25 of the housing member 13. These seals retain the epoxy at the lower end of the insulating coupler 11, when the bonding material is inserted into the clearance 33. The enlarged bore 64 in the upper end of the body 57 is also provided with an annular groove 72 which receives a seal 73 so as to provide a sealed connection between the insulating sleeve 65 and the body 57 (Figure 1C).

[0030] Defined in the outer surface 60 of the body 57 are a plurality of longitudinally extending grooves or channels 74 which commence a short distance below the upper end of the body 57 and extend substantially to the lower end thereof. The channels 74, which may number four, are circumferentially spaced about the body 57 and are shaped in cross-section to closely receive a sensing instrument or battery pack 75 either of which are designed in the form of an elongated member 76 having an outer or lower end 77 of reduced cross-section (Figures 1F and 2). The upper end of the instrument or battery pack has a threaded male portion which screws into a terminal block 80 (Figure 1C). Each channel 74 has a widened portion 81 at its upper end for receiving the terminal block 80 which is wider than the instrument or battery pack 75. The widened portion 81 further has opposed recesses for receiving opposed ears 83 of the terminal block 80 (Figure 2). The ears 83 are provided with holes to receive screws 84 which are threaded into threaded openings in the bottom of recesses so as to secure the terminal block and the upper end of the instrument or battery pack which is fastened thereto within the channel 74.

[0031] Passages or channels 84 interconnect the widened portions 81 of the channels 74, the channel 84 may receive cables for electrically interconnection of the terminal blocks. A channel 85 extends longitudinally from at least one of the widened portions 81 of the channel 74 to the upper end of the body 57. The channel 85 can be aligned with the short channel 56 at the bottom of the insulated housing member 13 so that the cable 57 can be accommodated for connection to screw 55 threaded into the housing member 13. The housing member 13 and the tubular section 20 and other sections thereabove, which are not insulated from the housing member, as previously described, may function as an antenna for transmitted information from the instrumentation mounted in the carrier device 12.

[0032] As can be seen in Figure 1F, there is provided at the lowermost end of the cylindrical body 57, a portion 86 of reduced diameter, and near the lower end of the portion 86 there are provided external threads 87. A tubular member 92 in the form of a substitute connector is threaded onto the outer end of the portion 86 by way of internal threads 90 in an enlarged bore 91 at the upper end of the tubular member 92. A lower end portion 93 of the tubular member 27 of reduced diameter is externally threaded for reception in an internal threaded portion of adjacent member of the tubular string below the apparatus 10. A bore 94, which is substantially the same diameter as the interior bore 61, extends longitudinally through the tubular member 92. Within the enlarged bore 91 above the internal threads 90 is an annular groove 95 which contains a seal 96.

[0033] The portion 86 which is of reduced diameter at the lower end of body 57 extends over the lower ends of the channels 74. A collar or ring member 97 which has an internal diameter only slightly larger than the outer diameter of the portion 86 is positioned between an upper end surface 100 and a shoulder 101 provided at the top of the portion 86. The ring member 97 is free to turn on the reduced portion 86 but there is provided a set screw 102 threaded through the ring and positioned to enter a radial bore 103 in the body 57 so as to lock the ring against rotation in a set position when the set screw 102 is turned in. The upper end portion of the ring member has an enlarged internal diameter to provide a skirt portion 104 having an internal surface 105. The internal diameter of the internal surface 105 is sufficient that it engages and encompasses the reduced lower ends 77 of the instrument or battery packs 75, thus normally holding the lower parts of such packs snugly within their respective channels 74. The skirt portion 104 of the

ring member 97 has a slot 106 (Figure 2) extending into the skirt from an upper edge of the skirt portion, the slot 106 having a width permitting movement of the reduced end portion 77 out through the slot in a direction which is radial relative to the body 57. Accordingly, when the set screw 102 is turned out and the ring member 97 is rotated to locate the slot 106 over a particular channel 74, the lower end of the battery pack or instrument pack located in that channel can be removed. By turning the elongated member 76 of the battery or instrument pack from its respective terminal block 80 at the upper end, the elongated member can be separated from the carrier device, or alternatively by removing the screws 84, the entire unit including the terminal block 80 can be removed.

[0034] It can be seen that the carrier device 12 provides a relatively simple and yet rugged structure for mounting in a protected manner the sensing means, the power source and the related instrumentation for obtaining and transmitting down-hole information, but which allows ready access of the equipment for replacement and servicing.

[0035] The lower end portion 40 of the tubular member or section 41 (Figure 1A) is of reduced diameter and is provided with external threads 107 for connection with threads 37 of tubular member 20. The tubular member 41 has an enlarged central bore 108 which extends downwardly a substantial distance from the upper end thereof. The upper portion of the enlarged bore 108 is threaded at 110 for connection to the adjacent tubular section above the apparatus 10. At the bottom of the enlarged central bore 108 there is a bore 111 of smaller diameter which communicates with a bore 112 of larger diameter extending upwardly from the bottom end of lower end portion 41 (Figure 1B). Received in the enlarged bore 108 is a by-pass core member 113 which has a blind central bore 114 positioned to communicate with a central bore of the next adjacent tubular member connected by way of threads 110. The central blind bore 114 communicates with the space exterior of the tubular string in the bore hole by way of radial ports 115. Extending upwardly from the bottom of the core is a blind bore 116 which is in communication with the bore 112 extending to the bottom of the tubular section 41. A supplementary, longitudinal passage 117 communicates with the blind bore 116 and the space adjacent the upper end of blind port 114 whereby fluid pressure within the bore 116 can be evacuated into the well borehole outside of the tubular string.

[0036] Extending from the bottom of the tubular member 41 to below the tubular member 92 is a by-pass tube 120, which is connected by insulating means to the tubular member 41, and is formed of a material, such as a high strength non conductive plastic. The by-pass tube 120 provides a fluid passageway 121 past the apparatus 10. As shown in Figure 1B the upper end of the tube 120 is externally threaded at 122 and is screwed into an insulating collar 123 which may be formed, for example, of Teflon. The lower exterior surface of collar 123 is tapered inwardly. A retainer 124 which has a matching tapered interior bore 125 and exterior threads 126 is turned into interior threads 127 within bore 112 at the bottom of tubular member 41. The collar 123 is received in the retainer and thus fastens the upper end of the tube 120 to the bottom of tubular member 41 and places the passageway 121 in communication within the passage 117. A tubular member of the same structure as 41, which provides a by-pass coupler at the upper end of apparatus 10 may be connected by way of threads 93 of tubular member 92 at the lower end of the apparatus 10 for completing the by-pass connection at that end.

[0037] The core member 113 within the central bore 180 of the tubular member 41 is also provided with a passageway 130. This passageway communicates at its upper end with the annular space 131 below the end of the tubular member next above tubular member 41, the space 131 being in communication with a fluid source which is controlled for transmitted fluid to controlled components, such as expandible sealing packers. The passageway 130 communicates with the space within the interior bore 42 of the tubular member 20 and outside of the exterior surface of the by-pass tube 120. This space continues to the lower end of the apparatus on the outside of the by-pass tube 120, as the interior bores of all of the other components through the apparatus are larger than the outside diameter of the by-pass tube 120. At the bottom of the apparatus communication is made between this space and a passageway (not shown) for separately conducting the fluid to its required location, such as the packer seal.

[0038] The by-pass tube 120 is utilized to place the space within the borehole below the apparatus in communication with the borehole above the apparatus. This is done via the central bore of the tubular members deeper in the hole which are in communication with the exterior of the tubular string through the passageway 121 of the by-pass tube 120 to the tubular member in the string above the apparatus. Accordingly, the build up of a pressure differential, which can force the tubular string upwardly or downwardly, is avoided.

Claims

1. A connector assembly for connection in a tubing string in a borehole, said connector assembly (11) electrically insulating an upper section of said string above said connector assembly from a lower section below said connector assembly and comprising:

   an outer housing member (13),
   an inner mandrel member (14),
   said housing member (13) having connection means (17) adjacent one end of said connector assembly (11) for end-to-end attachment of

said one end to one of said upper and lower sections of said string, and
said mandrel member (14) having second connection means (27) adjacent the other end of said connector assembly (11) for attachment of said other end of the other of said upper and lower sections,
and an electrical insulator (29) disposed between the housing member (13) and the mandrel member (14),

characterised in that

said housing member (13) has an internal surface (22) defining a tapered opening (16) through said connection means (17), said internal surface (22) including an internal bore of a large diameter toward one end of said housing member (13) and an internal bore (23) of a smaller diameter toward the opposite end of said housing member (13), the tapered opening (16) extending longitudinally from said bore of larger diameter to said bore (23) of smaller diameter,
said mandrel member (14) has an exterior surface (32) tapering from a large diameter end portion toward said other end and terminating at a cylindrical end portion (34) defining an exterior surface of smaller diameter, said larger diameter of said exterior surface (32) of said mandrel member (14) being of greater diameter than said bore (23) of smaller diameter in said housing member (13), and said exterior surface (32) of said mandrel member (14) being disposed within said internal surface (22) of said housing member (13) and providing a clearance (33) between said surfaces (22,32), and said electrical insulator (29) comprises an electrically non-conducting bond material disposed within said clearance (33) between said surfaces (22,32).

2. A connector assembly as defined in claim 1, characterized in that said connection means of said housing member (13) includes threaded means (17) for connection of said housing member (13) to a tubular member (20) thereabove, and said connection means of said mandrel member (14) includes a threaded portion (27) of said mandrel member (14) for connection to a tubular member (57) therebelow.

3. A connector assembly as defined in claim 1 or 2, characterized in that said internal surface (22) of said housing member (13) has a cylindrical portion (23) which includes a plurality of circumferentially spaced, longitudinally extending grooves (24), in that said exterior surface (32) thereof disposed within but radially separated from said cylindrical portion (23) of said internal surface (22) of said housing member (13), said cylindrical portion (34) of said mandrel member (14) having a plurality of circumferentially spaced, longitudinally extending grooves (35) oppositely aligned with said grooves (24) in said cylindrical portion (23) of said internal surface (22) of said housing member (13), and in that a plurality of members (36) are each disposed in an oppositely aligned pair of said grooves (24, 35) of said portions (23, 34) of said internal and exterior surfaces (22, 32).

4. A connector assembly as defined in claim 3, characterized in that said members disposed in said grooves are rod-like members (36) formed of electrically insulating material.

5. A connector assembly as defined in claim 3 or 4, characterized in that said longitudinally extending grooves (24, 35) are of substantially semi-circular cross-section, and said members (36) are of substantially circular cross-section.

6. A connector assembly as defined in any of the preceding claims, characterized in that said bond material (29) is also disposed amongst said plurality of members (36).

7. A connector assembly as defined in any of the preceding claims, characterized in that said connection means of said housing member (13) includes threaded means (17) within said bore of larger diameter, in that a first tubular member (20) is provided having a threaded lower end portion (21) for threaded interconnection within said bore of larger diameter, and in that said first tubular member (20) includes upper thread means (37) for connection to a second tubular member (41) thereabove.

8. A connector assembly as defined in any of the preceding claims, characterized in that said mandrel member (14) has a central longitudinal bore (30) extending therethrough and an enlarged bore (31) extending downwardly from said larger diameter end portion and terminating at a first radial shoulder (45), in that said first tubular member (20) has a central bore (42) extending therethrough with a lower end portion of said first tubular member (20) being disposed within said housing member (13), said lower end portion of said first tubular member (20) being provided with an enlarged bore (43) extending upwardly and terminating at a second radial shoulder (44), and in that a sleeve member (46) is disposed in the enlarged bores (31, 43) of said mandrel member (14) and said first tubular member (20), said sleeve member (46) being formed of electrically insulating material and having opposite ends

in abutment with said first and second radial shoulders (45, 44).

9. A connector assembly as defined in any of the preceding claims, characterized in that an instrument carrier device (12) including an elongated tubular member (57) having external channels (74) for accommodating instrument sensing units (75) is located below said mandrel member (14) and is connected to a threaded portion (27) of said mandrel member (14), said tubular member (57) having an internal passageway (61), in that said tubular member (57) has a third connection means (87) at a lower end thereof for attachment of said carrier device (12) to an adjacent section of said tubing string below said carrier device (12), and in that said mandrel member (14) is of tubular form defining a central passageway (30) therethrough, said internal passageway (61) of said carrier device (12) communicating at an upper end with said passageway (30) in said mandrel member (14).

10. A connector assembly as defined in claim 9, characterized in that an electrically insulating by-pass tube (120) extends through said passageways (30, 61) of said mandrel (14) and said carrier device (12) forming a fluid passageway (121), said by-pass tube (120) having fourth and fifth connection means (122, 93) at upper and lower ends thereof, respectively, for connection of opposite ends of said by-pass tube (120), to said upper and lower sections for permitting fluid passage through said connector assembly (11) and said carrier device (12).

11. A connector assembly as defined in claim 10, characterized in that said central passageways (30,61) in said mandrel member (14) and said tubular member (57) of said carrier device (12) are of greater cross-section than said by-pass tube (120) whereby a space is provided exteriorly of said by-pass tube (120) to form a second fluid passageway, means being received within the threaded bore of said housing member 13) and thereby connecting thereinto a tubular by-pass connector (113) having a bore (114) therein and port means (115) for placing said bore (114) of said by-pass connection (113) in communication with said borehole containing said tubing string, and in that means are provided for connecting said insulating by-pass tube (120) to said by-pass connector (113), including means defining a passageway placing said by-pass tube (120) in communication with said bore (114) of said by-pass connector (113).

12. A subsurface signal transmitting apparatus incorporating a connector assembly as defined in any of the preceding claims.

Patentansprüche

1. Verbinderanordnung für eine Verbindung in einem Rohrstrang in einem Bohrloch, wobei die Verbinderanordnung (11) einen oberen Abschnitt des Stranges über der Verbinderanordnung von einem unteren Abschnitt unter der Verbinderanordnung elektrisch isoliert und aufweist:

ein äußeres Gehäuseelement (13);
ein inneres Futterrohrelement (14);
wobei das Gehäuseelement (13) eine Verbindungseinrichtung (17) angrenzend an ein Ende der Verbinderanordnung (11) für eine Ende-an-Ende-Befestigung des einen Endes an einem von oberem und unterem Abschnitt des-Stranges aufweist, und
wobei das Futterrohrelement (14) eine zweite Verbindungseinrichtung (27) angrenzend an das andere Ende der Verbinderanordnung (11) für eine Befestigung des anderen Endes des anderen von oberem und unterem Abschnitt aufweist;
und einen elektrischen Isolator (29), der zwischen dem Gehäuseelement (13) und dem Futterrohrelement (14) angeordnet ist,

dadurch gekennzeichnet, daß

das Gehäuseelement (13) eine Innenfläche (22) aufweist, die eine konische Öffnung (16) durch die Verbindungseinrichtung (17) definiert, wobei die Innenfläche (22) umfaßt: eine Innenbohrung mit einem großen Durchmesser zu einem Ende des Gehäuseelementes (13) hin; und eine Innenbohrung (23) mit einem kleineren Durchmesser zum entgegengesetzten Ende des Gehäuseelementes (13) hin, wobei sich die konische Öffnung (16) in Längsrichtung von der Bohrung mit größerem Durchmesser zur Bohrung (23) mit kleinerem Durchmesser erstreckt;
das Futterrohrelement (14) eine Außenfläche (32) aufweist, die von einem Endabschnitt mit großem Durchmesser zum anderen Ende konisch verläuft und in einem zylindrischen Endabschnitt (34) endet, der eine Außenfläche mit kleinerem Durchmesser definiert, wobei der größere Durchmesser der Außenfläche (32) des Futterrohrelementes (14) ein größerer Durchmesser ist als die Bohrung (23) mit kleinerem Durchmesser im Gehäuseelement (13), und wobei die Außenfläche (32) des Futterrohrelementes (14) innerhalb der Innenfläche (22) des Gehäuseelementes (13) angeordnet ist und einen Zwischenraum (33) zwischen den Flächen (22, 32) bereitstellt; und
der elektrische Isolator (29) einen elektrisch

nichtleitenden Klebstoff aufweist, der innerhalb des Zwischenraumes (33) zwischen den Flächen (22, 32) angeordnet ist.

2. Verbinderanordnung nach Anspruch 1, dadurch gekennzeichnet, daß die Verbindungseinrichtung des Gehäuseelementes (13) eine Gewindeeinrichtung (17) für eine Verbindung des Gehäuseelementes (13) mit einem Rohrelement (20) darüber umfaßt; und daß die Verbindungseinrichtung des Futterrohrelementes (14) einen Gewindeabschnitt (27) des Futterrohrelementes (14) für eine Verbindung mit einem Rohrelement (57) darunter umfaßt.

3. Verbinderanordnung nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Innenfläche (22) des Gehäuselementes (13) einen zylindrischen Abschnitt (23) aufweist, der eine Vielzahl von peripher mit Abstand angeordneten sich in Längsrichtung erstreckenden Nuten (24) umfaßt; daß die Außenfläche (32) davon innerhalb des aber radial getrennt vom zylindrischen Abschnitt (23) der Innenfläche (22) des Gehäuseelementes (13) angeordnet ist, wobei der zylindrische Abschnitt (34) des Futterrohrelementes (14) eine Vielzahl von peripher mit Abstand angeordneten sich in Längsrichtung erstrekkenden Nuten (35) aufweist, die gegenüberliegend mit den Nuten (24) im zylindrischen Abschnitt (23) der Innenfläche (22) des Gehäuseelementes (13) ausgerichtet sind; und daß eine Vielzahl von Elementen (36) jeweils in einem gegenüberliegend ausgerichteten Paar von Nuten (24, 35) der Abschnitte (23, 34) der Innen- und Außenfläche (22, 32) angeordnet ist.

4. Verbinderanordnung nach Anspruch 3, dadurch gekennzeichnet, daß die in den Nuten angeordneten Elemente stabartige Elemente (36) sind, die aus einem elektrisch isolierenden Material hergestellt sind.

5. Verbinderanrodnung nach Anspruch 3 oder 4, dadurch gekennzeichnet, daß die sich in Längsrichtung erstreckenden Nuten (24, 35) einen im wesentlichen halbkreisförmigen Querschnitt aufweisen; und daß die Elemente (36) einen im wesentlichen kreisförmigen Querschnitt aufweisen.

6. Verbinderanordnung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß der Klebstoff (29) ebenfalls zwischen der Vielzahl der Elemente (36) angeordnet ist.

7. Verbinderanordnung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die Verbindungseinrichtung des Gehäuseelementes (13) eine Gewindeeinrichtung (17) innerhalb der Bohrung mit größerem Durchmesser umfaßt; daß ein erstes Rohrelement (20) bereitgestellt wird, das einen mit Gewinde versehenen unteren Endabschnitt (21) für eine Gewindeverbindung innerhalb der Bohrung mit größerem Durchmesser aufweist; und daß das erste Rohrelement (20) eine obere Gewindeeinrichtung (37) für eine Verbindung mit einem zweiten Rohrelement (41) darüber umfaßt.

8. Verbinderanordnung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß das Futterrohrelement (14) eine mittlere Längsbohrung (30), die sich dort hindurch erstreckt, und eine vergrößerte Bohrung (31) aufweist, die sich vom Endabschnitt mit größerem Durchmesser nach unten erstreckt und in einem ersten radialen Vorsprung (45) endet; daß das erste Rohrelement (20) eine mittlere Bohrung (42) aufweist, die sich dort hindurch erstreckt, wobei ein unterer Endabschnitt des ersten Rohrelementes (20) innerhalb des Gehäuseelementes (13) angeordnet ist, wobei der untere Endabschnitt des ersten Rohrelementes (20) mit einer vergrößerten Bohrung (43) versehen ist, die sich nach oben erstreckt und in einem zweiten radialen Vorsprung (44) endet; und daß ein Buchselement (46) in den vergrößerten Bohrungen (31, 43) des Futterrohrelementes (14) und des ersten Rohrelementes (20) angeordnet ist, wobei das Buchsenelement (46) aus elektrisch isolierendem Material hergestellt ist und entgegengesetzte Enden aufweist, die an den ersten und den zweiten radialen Vorsprung (45, 44) anstoßen.

9. Verbinderanordnung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß eine Geräteträgervorrichtung (12), die ein längliches Rohrelement (57) mit äußeren Kanälen (74) für das Aufnehmen von Gerätemeßbauteilen (75) umfaßt, unter dem Futterrohrelement (14) angeordnet und mit einem Gewindeabschnitt (27) des Futterrohrelementes (14) verbunden ist, wobei das Rohrelement (57) einen inneren Durchgang (61) aufweist; daß das Rohrelement (57) eine dritte Verbindungseinrichtung (87) an einem unteren Ende davon für eine Befestigung der Trägervorrichtung (12) an einem benachbarten Abschnitt des Rohrstranges unter der Trägervorrichtung (12) aufweist; und daß das Futterrohrelement (14) eine Rohrform aufweist, die einen mittleren Durchgang (30) dort hindurch definiert, wobei der innere Durchgang (61) der Trägervorrichtung (12) an einem oberen Ende mit dem Durchgang (30) im Futterrohrelement (14) verbunden ist.

10. Verbinderanordnung nach Anspruch 9, dadurch gekennzeichnet, daß sich ein elektrisch isolierendes Überbrückungsrohr (120) durch die Durchgänge (30, 61) des Futterrohres (14) und der Trägervorrichtung (12) erstreckt, wodurch ein Durchgang

(121) für ein fließendes Medium gebildet wird, wobei das Überbrückungsrohr (120) eine vierte und fünfte Verbindungseinrichtung (122, 93) an dessen oberen und bzw. unteren Ende für eine Verbindung der entgegengesetzten Enden des Überbrückungsrohres (120) mit dem oberen und unteren Abschnitt aufweist, um den Durchgang des fließenden Mediums durch die Verbinderanordnung (11) und die Trägervorrichtung (12) zu gestatten.

11. Verbinderanordnung nach Anspruch 10, dadurch gekennzeichnet, daß die mittleren Durchgänge (30, 61) im Futterrohrelement (14) und Rohrelement (57) der Trägervorrichtung (12) einen größeren Querschnitt aufweisen als das Überbrückungsrohr (120), wodurch ein Raum außerhalb des Überbrükkungsrohres (120) bereitgestellt wird, um einen zweiten Durchgang für das fließende Medium zu bilden, wobei die Einrichtung innerhalb der Gewindebohrung des Gehäuseelementes (13) aufgenommen wird und dadurch darin eine Verbindung mit einem rohrförmigen Überbrückungsverbinder (113) bewirkt, der eine Bohrung (114) darin und eine Anschlußeinrichtung (Öffnung) (115) für das Anordnen der Bohrung (114) der Überbrückungsverbindung (113) in Verbindung mit dem Bohrloch aufweist, das den Rohrstrang enthält; und daß eine Einrichtung für das Verbinden des isolierenden Überbrückunungsrohres (120) mit dem Überbrückungsverbinder (113) bereitgestellt wird, die eine Einrichtung umfaßt, die einen Durchgang definiert, der das Überbrückungsrohr (120) in Verbindung mit der Bohrung (114) des Überbrückungsverbinders (113) anordnet.

12. Unterirdische Signalübertragungsvorrichtung, die eine Verbinderanordnung nach einem der vorhergehenden Ansprüche enthält.

Revendications

1. Assemblage de raccordement pour le raccordement dans une colonne de production dans un trou de forage, ledit assemblage de raccordement (11) isolant électriquement une section supérieure de ladite colonne au-dessus dudit assemblage de raccordement d'une section inférieure au-dessous dudit assemblage de raccordement et comprenant:

un élément de boîtier externe (13),
un élément de mandrin interne (14),
ledit élément e boîtier (13) comportant un moyen de raccordement (17) adjacent à une extrémité dudit assemblage de raccordement (11) destiné à assurer une fixation bout à bout de ladite une extrémité à une desdites sections supérieure et inférieure de ladite colonne de production, et
ledit élément de mandrin (14) comportant un deuxième moyen de raccordement (27) adjacent à ladite autre extrémité dudit assemblage de raccordement (11) destiné à assurer la fixation de ladite autre extrémité de l'autre desdites sections supérieure et inférieure,
et un isolateur électrique (29) agencé entre l'élément de boîtier (13) et l'élément de mandrin (14),

caractérisé en ce que

ledit élément de boîtier (13) comporte une surface interne (22) définissant une ouverture effilée (16) à travers ledit moyen de raccordement (17), ladite surface interne (22) englobant un alésage interne de grand diamètre orienté vers une extrémité dudit élément de boîtier (13) et un alésage interne (23) de diamètre réduit orienté vers l'extrémité opposée dudit élément de boîtier (13), l'ouverture effilée (16) s'étendant longitudinalement dudit alésage de diamètre accru vers ledit alésage (23) de diamètre réduit,
ledit élément de mandrin (14) comporte une surface externe (32) effilée d'une partie d'extrémité de grand diamètre vers ladite autre extrémité et se terminant au niveau d'une partie d'extrémité cylindrique (34) définissant une surface externe de diamètre réduit, ledit diamètre accru de ladite surface externe (32) dudit élément de mandrin (14) ayant un diamètre supérieur à celui dudit alésage (23) de diamètre réduit dans ledit élément de boîtier (13) et ladite surface externe (32) dudit élément de mandrin (14) étant agencée dans ladite surface interne (22) dudit élément de boîtier (13) et établissant un dégagement (33) entre lesdites surfaces (22, 32), et
ledit isolateur électrique (29) comprend un matériau de liaison non conducteur d'électricité agencé dans ledit dégagement (33) entre lesdites surfaces (22, 32).

2. Assemblage de raccordement selon la revendication 1, caractérisé en ce que ledit moyen de raccordement dudit élément de boîtier (13) englobe un moyen fileté (17) pour connecter ledit élément de boîtier (13) à un élément tubulaire (20) agencé au-dessus, ledit moyen de raccordement dudit élément de mandrin (14) englobant une partie filetée (27) dudit élément de mandrin (14) en vue du raccordement à un élément tubulaire (57) agencé au-dessous.

3. Assemblage de raccordement selon les revendications 1 ou 2, caractérisé en ce que ladite surface interne (22) dudit élément de boîtier (13) comporte

une partie cylindrique (23) englobant plusieurs rainures à espacement circonférentiel et à extension longitudinale (24), en ce que ladite surface externe (32) correspondante est agencée dans ladite partie cylindrique (23) de ladite surface interne (22) dudit élément de boîtier (13), mais est sépare radialement de celle-ci, ladite partie cylindrique (34) dudit élément de mandrin (14) comportant plusieurs rainures à espacement circonférentiel et à extension longitudinale (35) alignées de manière opposée avec lesdites rainures (24) dans ladite partie cylindrique (23) de ladite surface interne (22) dudit élément de boîtier (13), et en ce que plusieurs éléments (36) sont agencés chacun en une paire à opposition alignée desdites rainures (24, 35) desdites parties (23, 24) desdites surfaces interne et externe (22, 23).

4. Assemblage de raccordement selon la revendication 3, caractérisé en ce que lesdits éléments agencés dans lesdites rainures sont des éléments en forme de tige (36) composés d'un matériau à isolation électrique.

5. Assemblage de raccordement selon les revendications 3 ou 4, caractérisé en ce que lesdites rainures à extension longitudinale (24, 35) ont une section transversale pratiquement semi-circulaire, lesdits éléments (36) ayant une section transversale pratiquement circulaire.

6. Assemblage de raccordement selon l'une quelconque des revendications précédentes, caractérisé en ce que ledit matériau de liaison (29) est également agencé entre lesdits plusieurs éléments (36).

7. Assemblage de raccordement selon l'une quelconque des revendications précédentes, caractérisé en ce que ledit moyen de raccordement dudit élément de boîtier (13) englobe un moyen fileté (17) dans ledit alésage de diamètre accru, en ce qu'un premier élément tubulaire (20) comporte une partie d'extrémité inférieure filetée (21) en vue d'un raccordement fileté dans ledit alésage de diamètre accru, et en ce que ledit premier élément tubulaire (20) englobe un moyen fileté supérieur (37) en vue du raccordement à un deuxième élément tubulaire (41) agencé au-dessus.

8. Assemblage de raccordement selon l'une quelconque des revendications précédentes, caractérisé en ce que ledit élément de mandrin (14) comporte un alésage central longitudinal (30) le traversant, et un alésage agrandi (31) s'étendant vers le bas à partir de ladite partie d'extrémité de diamètre accru et se terminant au niveau d'un premier épaulement radial (45), en ce que ledit premier élément tubulaire (20) comporte un alésage central (42) le traversant, une partie d'extrémité inférieure dudit premier élément tubulaire (20) étant agencée dans ledit élément de boîtier (13), ladite partie d'extrémité inférieure dudit premier élément tubulaire (20) comportant un alésage agrandi (43) s'étendant vers le haut et se terminant au niveau d'un deuxième épaulement radial (44), en ce qu'un élément de manchon (46) est agencé dans les alésages agrandis (31, 43) dudit élément de mandrin (14) et dudit premier élément tubulaire (20), ledit élément de manchon (46) étant composé de matériau à isolation électrique et comportant des extrémités opposées butant contre lesdits premier et deuxième épaulements radiaux (45, 44).

9. Assemblage de raccordement selon l'une quelconque des revendications précédentes, caractérisé en ce qu'un dispositif de support des instruments (12) englobant un élément tubulaire allongé (57) comportant des canaux externes (74) destinés à recevoir les unités de détection des instruments (75) est agencé au-dessous dudit élément de mandrin (14) et est connecté à une partie filetée (27) dudit élément de mandrin (14), ledit élément tubulaire (57) comportant un passage interne (61), en ce que ledit élément tubulaire (57) comporte un troisième moyen de raccordement (87) au niveau d'une extrémité inférieure correspondante pour fixer ledit dispositif de support (12) à une section adjacente de ladite colonne de production au-dessous dudit dispositif de support (12), et en ce que ledit élément de mandrin (14) a une forme tubulaire définissant un passage central (30) le traversant, ledit passage interne (61) dudit dispositif de support (12) communiquant au niveau d'une extrémité supérieure avec ledit passage (30) dans ledit élément de mandrin (14).

10. Assemblage de raccordement selon la revendication 9, caractérisé en ce qu'un tube de dérivation à isolation électrique (120) s'étend à travers lesdits passages (30, 61) dudit mandrin (14) et dudit dispositif de support (12), formant un passage de fluide (121), ledit tube de dérivation (120) comportant respectivement des quatrième et cinquième moyens de raccordement (122, 93) au niveau des extrémités supérieure et inférieure correspondantes, pour le raccordement des extrémités opposées dudit tube de dérivation (120) auxdites sections supérieure et inférieure, pour permettre le passage de fluide à travers ledit assemblage de raccordement (11) et ledit dispositif de support (12).

11. Assemblage de raccordement selon la revendication 10, caractérisé en ce que lesdits passages centraux (30, 61) dans ledit élément de mandrin (14) et ledit élément tubulaire (57) dudit dispositif de support (12) ont une section transversale supérieure à

celle dudit tube de dérivation (120), un espace étant ainsi établi à l'extérieur dudit tube de dérivation (120) pour former un deuxième passage de fluide, un moyen étant reçu dans l'alésage fileté dudit élément de boîtier (13) et y connectant ainsi un raccord de dérivation tubulaire (113) comportant un alésage (114) et un moyen d'orifice (115) pour établir une communication entre ledit alésage (114) dudit raccord de dérivation (113) et ledit trou de forage contenant ladite colonne de production, et en ce que des moyens servent à raccorder ledit tube de dérivation isolant (120) audit raccord de dérivation (113), englobant des moyens définissant un passage établissant une communication entre ledit tube de dérivation (120) et ledit alésage (114) dudit raccord de dérivation (113).

12. Emetteur souterrain de signaux comportant un assemblage de raccordement comme défini dans l'une quelconque des revendications précédentes.

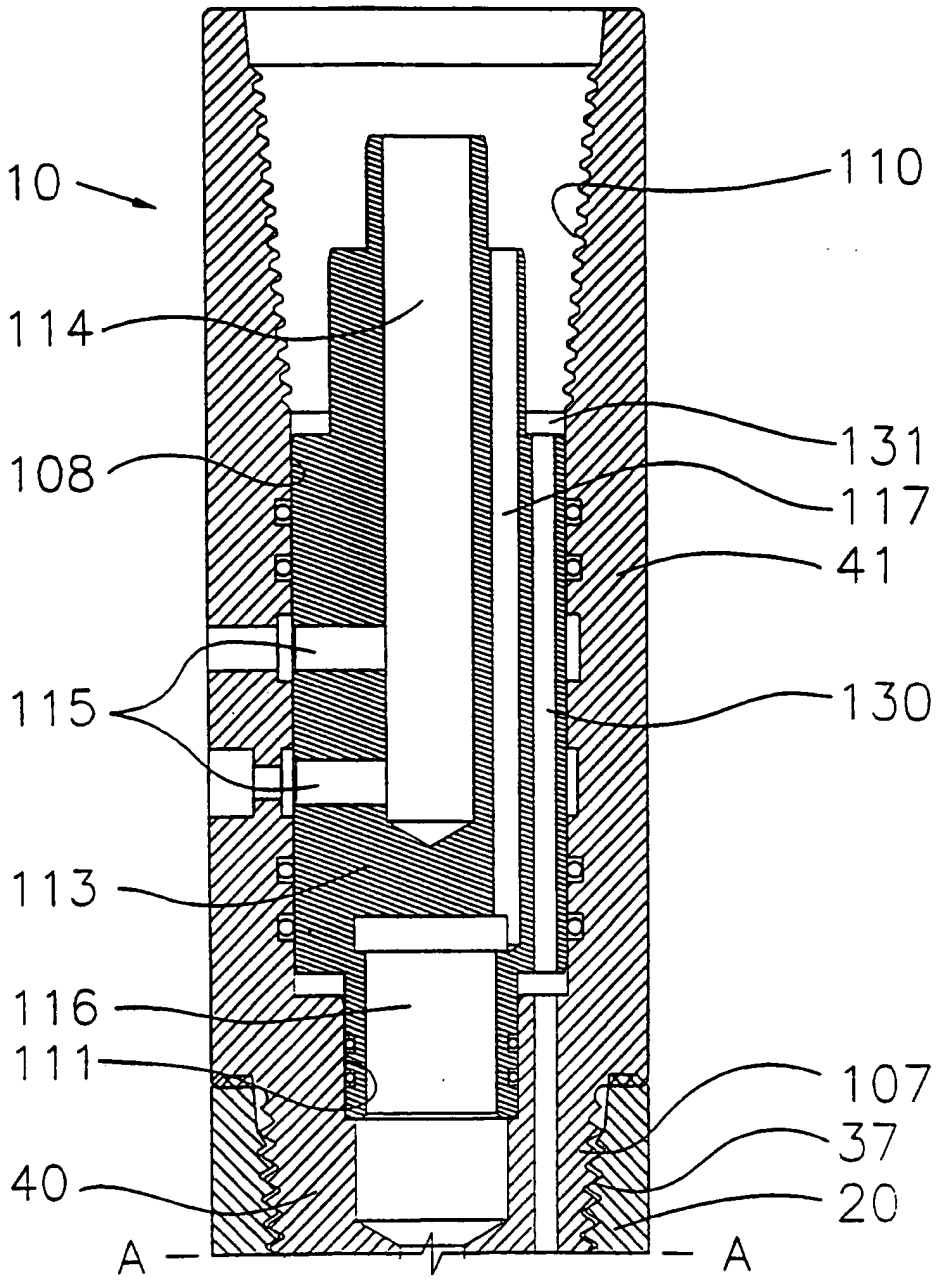

FIG 1A

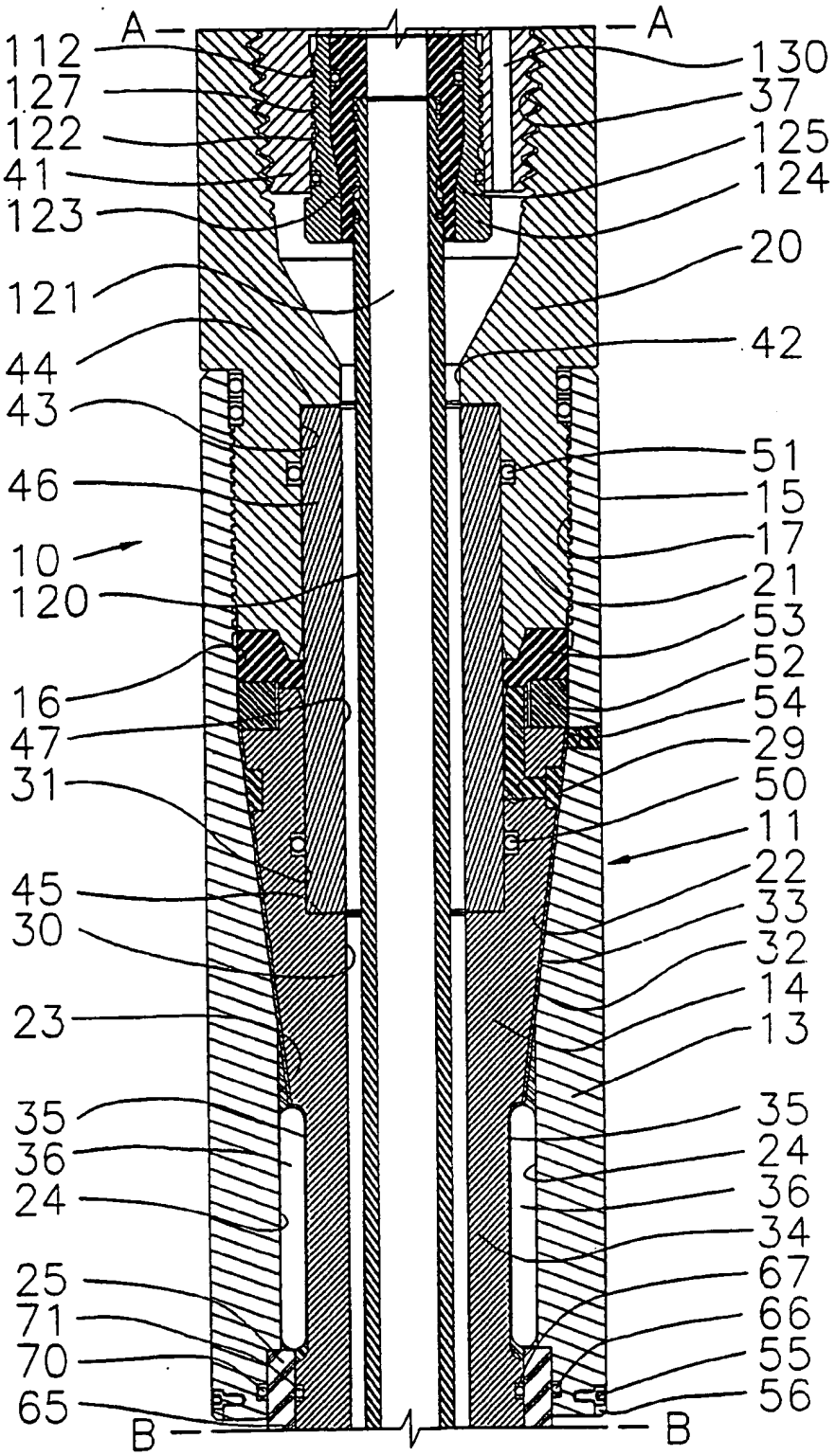
A
A
112
127
122
41
123
121
44
43
46
10
120
16
47
31
45
30
23
35
36
24
25
71
70
65
B
B
130
37
125
124
20
42
51
15
17
21
53
52
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FIG 1B

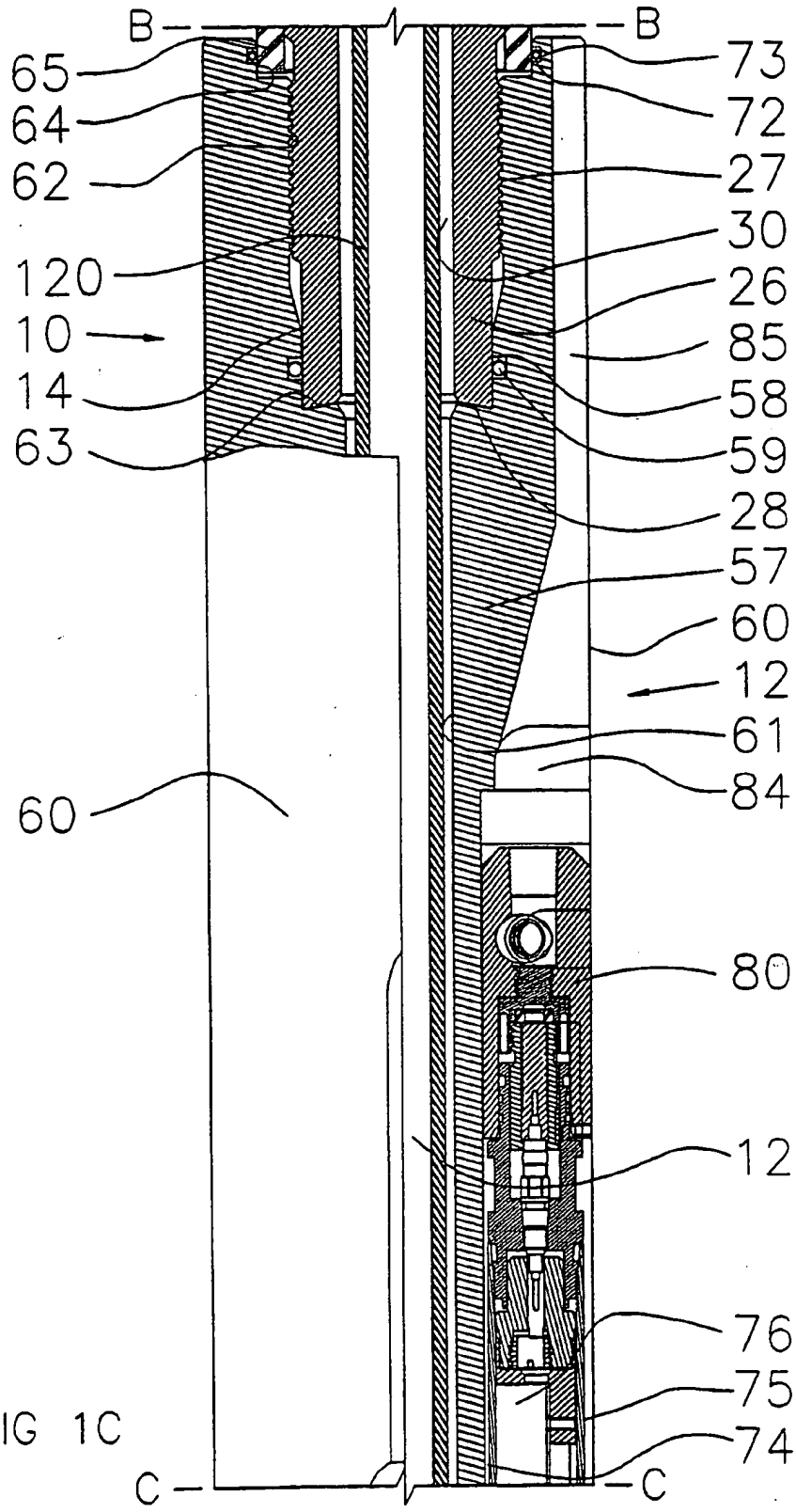
B
B
65
64
62
120
10
14
63
60
73
72
27
30
26
85
58
59
28
57
60
12
61
84
80
121
76
75
74
C
C

FIG 1C

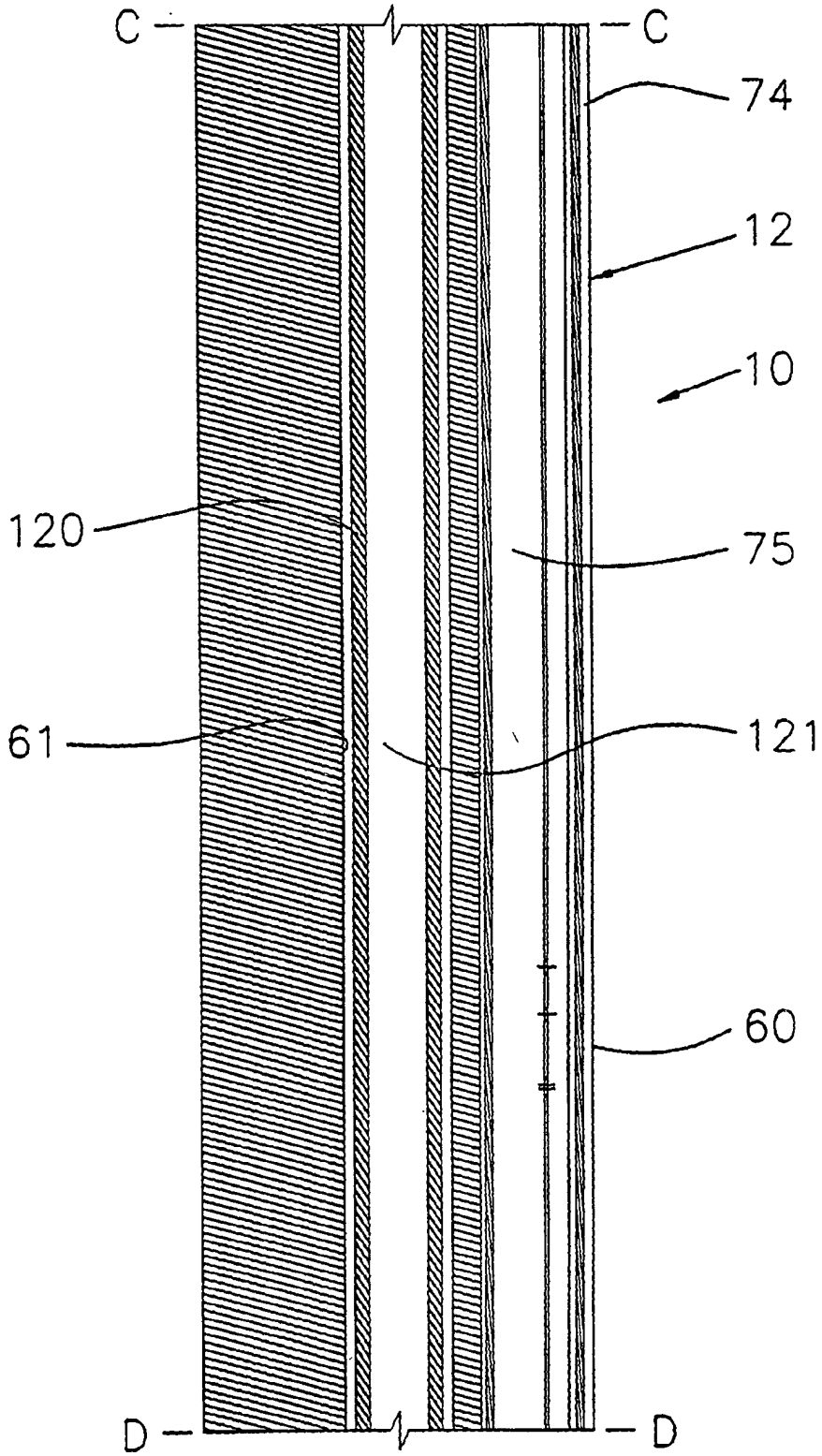

FIG 1D

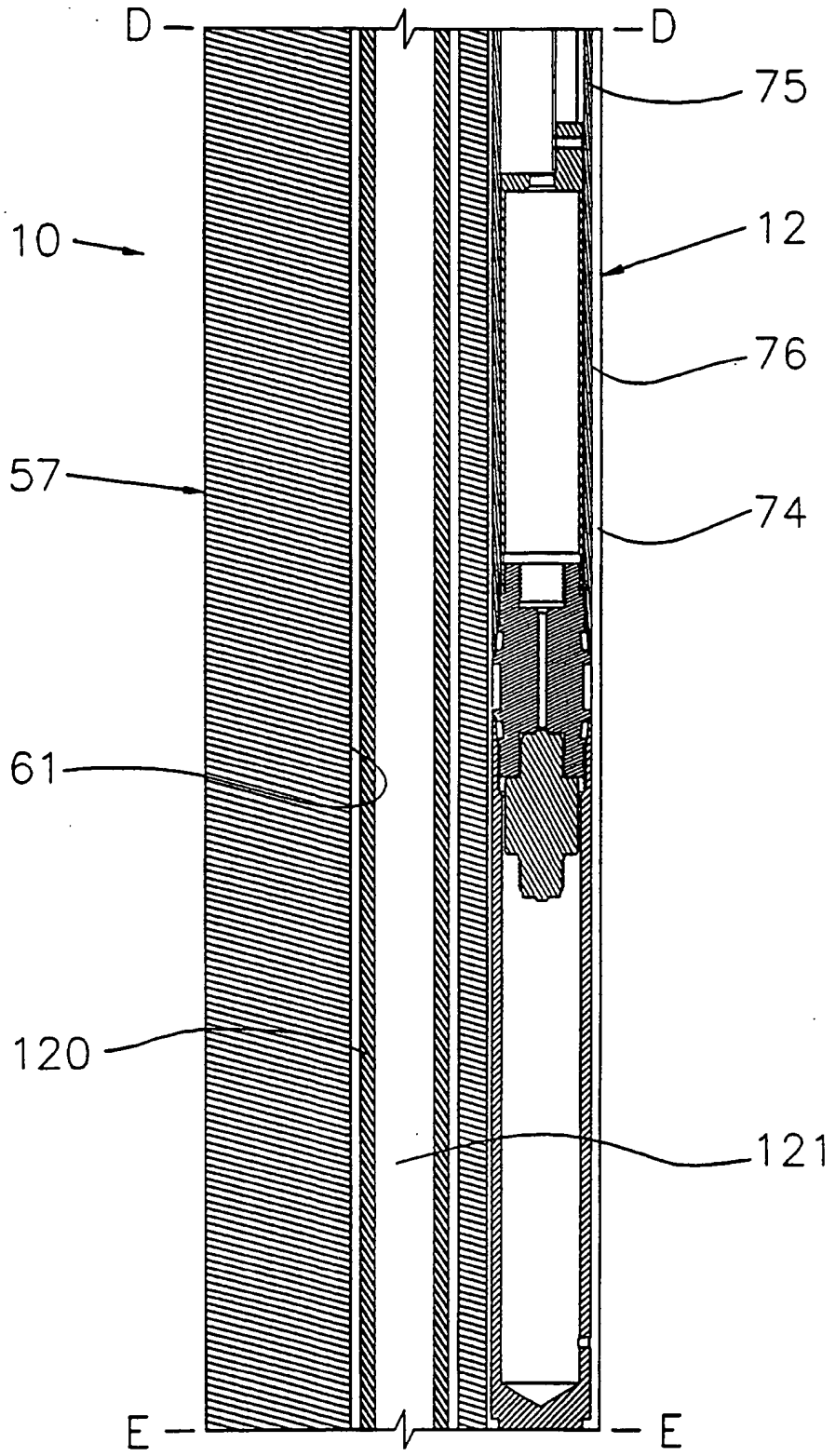

FIG 1E

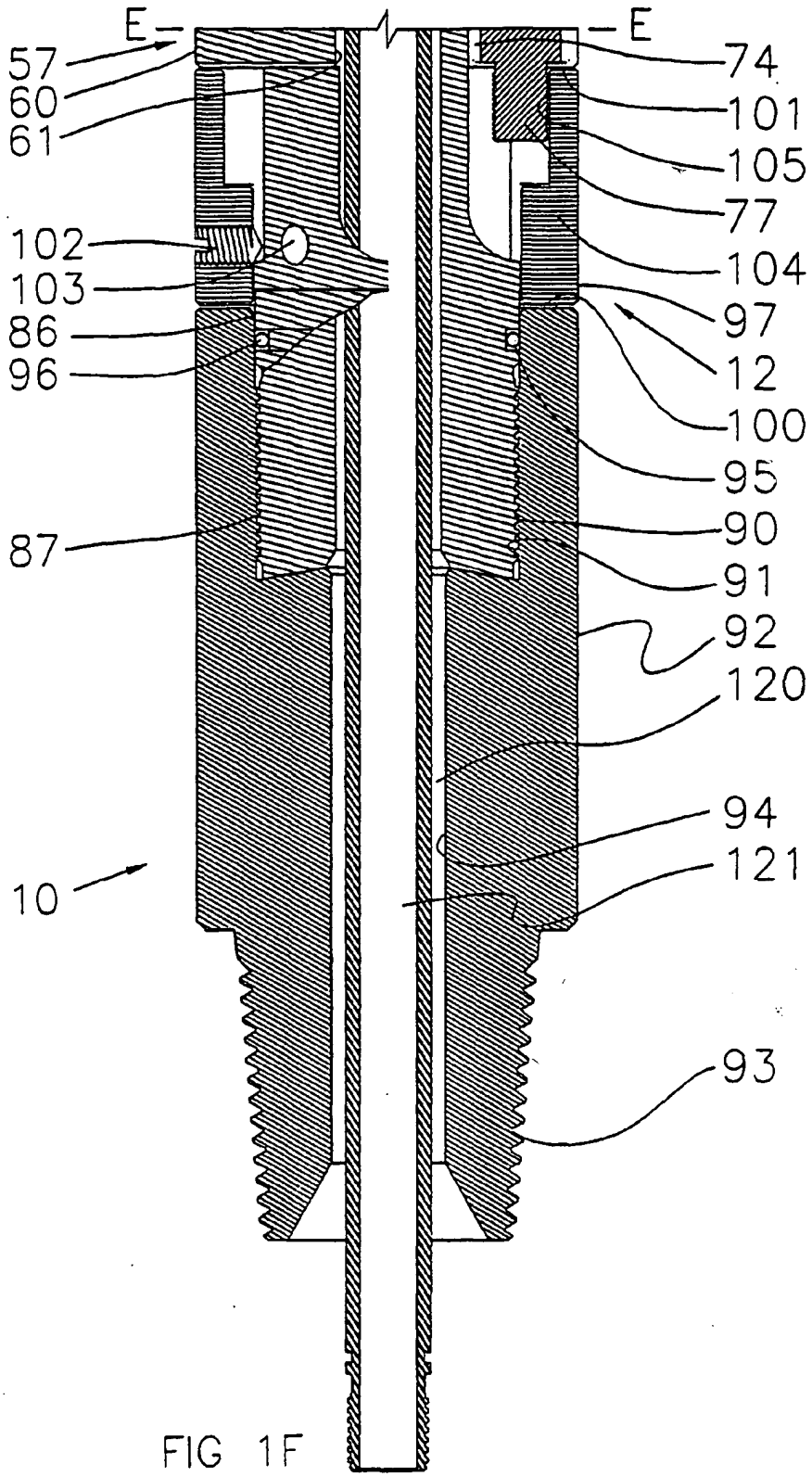
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FIG 1F

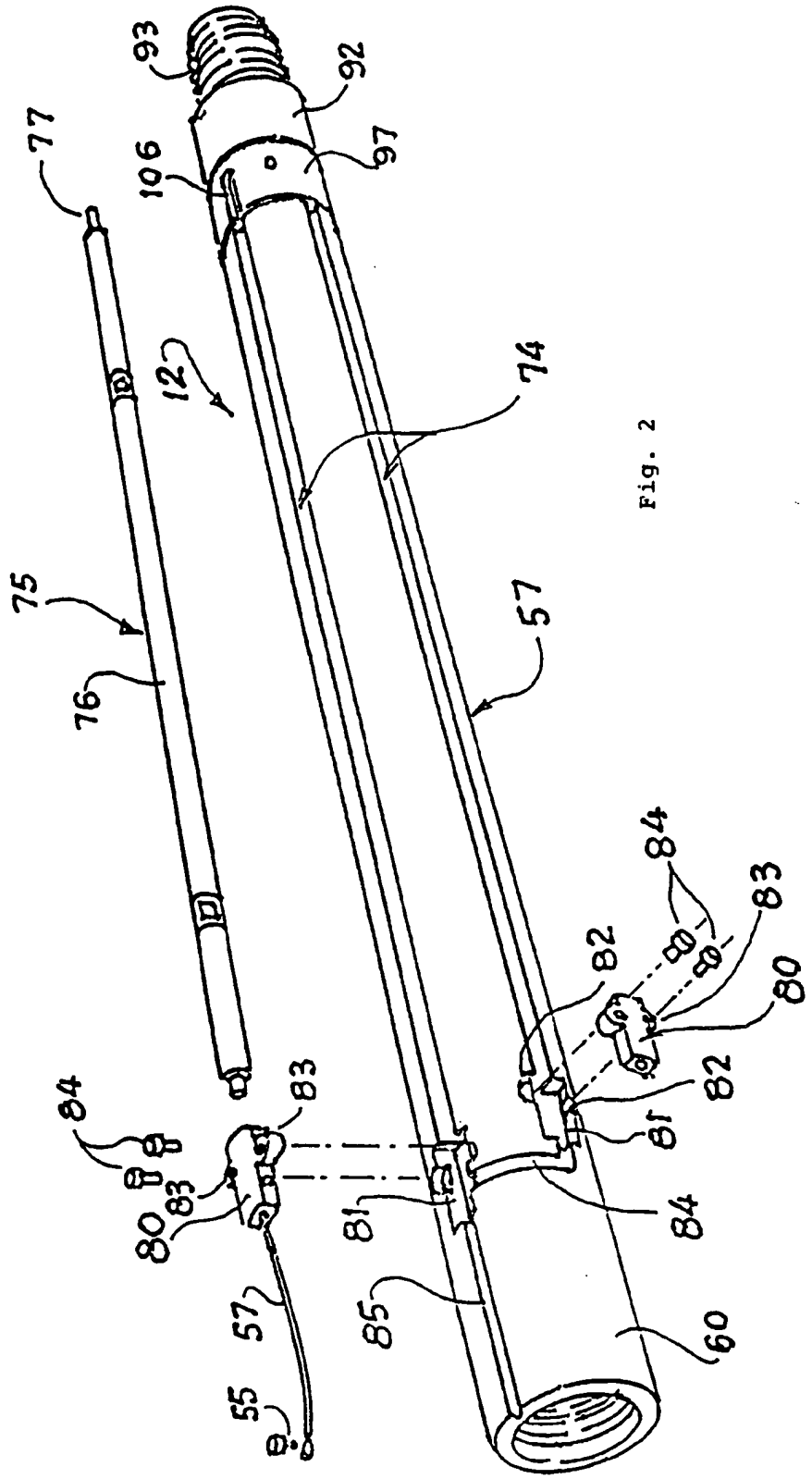

Fig. 2